Short introduction to ZeroMQ

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Writing network application

Sockets

- low-level
- quite hard to use
- you have to do everything

AMQ

- message based with various patterns
- mainly used in Java world
- broker based
  ⇒ little complicated to get to started

ZeroMQ

- easy to use
- fast and asynchronous
- message based
- broker is not required
- plenty of ready made scenarios
- active community
- additional extra features
- not only network - ipc as well
- bindings for various languages
  - PHP, Python, Lua, Haxe, C++, C#, CL, Delphi, Erlang, F#, Felix, Haskell, Java, Objective-C, Ruby, Ada, Basic, Clojure, Go, Haxe, Node.js, ooc, Perl, and Scala

General recommendations

- distributed systems are hard
- having central component means having single point of failure
  - if you have broker, make it as simple as possible
  - better to know how to recover than to avoid inevitable
- use CZMQ - high-level API
  - other nice features - zactor, zauth, zbeacon
- use simplest pattern possible

Sockets example

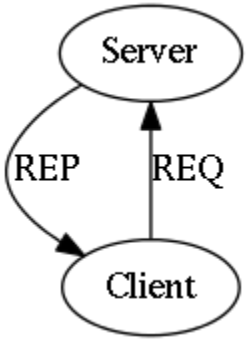
```
struct hostent *he;
struct sockaddr_in addr;

he = gethostbyname(hostname);
sockfd = socket(AF_INET, SOCK_STREAM, 0);
addr.sin_family = AF_INET;
addr.sin_port = htons(PORT);
addr.sin_addr = *((struct in_addr *)he->h_addr);
memset(&(addr.sin_zero), '\0', 8);

connect(sockfd, (struct sockaddr *)&addr,
   sizeof(struct sockaddr));

numbytes = recv(sockfd, buf, MAXDATASIZE-1, 0);
buf[numbytes] = '\0';
close(sockfd);
```

ZeroMQ example

```
void *context = zmq_ctx_new ();

//  Socket to talk to server
void *requester = zmq_socket (context, ZMQ_REQ);
zmq_connect (requester, "tcp://localhost:5559");

for (int i = 0; i != 10; i++) {
  s_send (requester, "Hello");
  char *string = s_recv (requester);
  printf ("Received reply %d [%s]\n", i, string);
  free (string);
}

zmq_close (requester);
zmq_ctx_destroy (context);
```

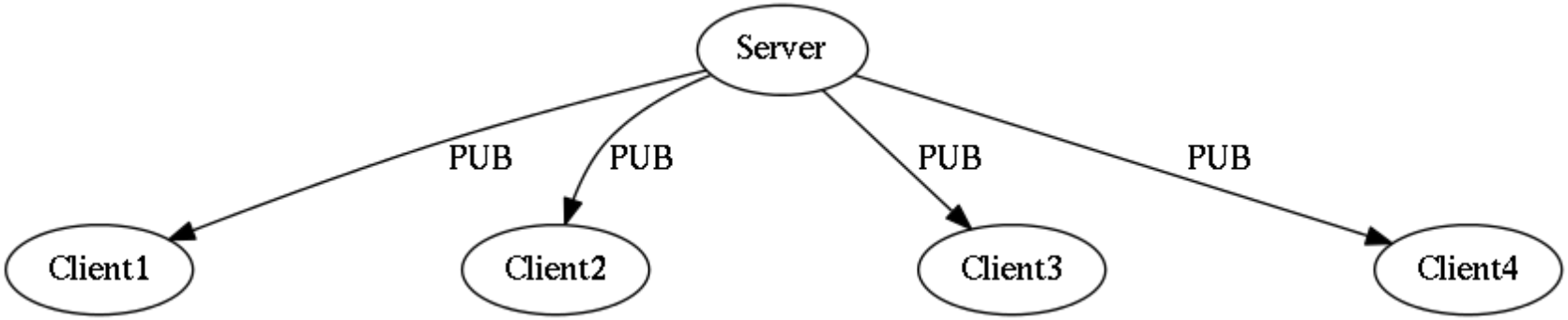
Request-Reply

- simplest form of communication
- reliable



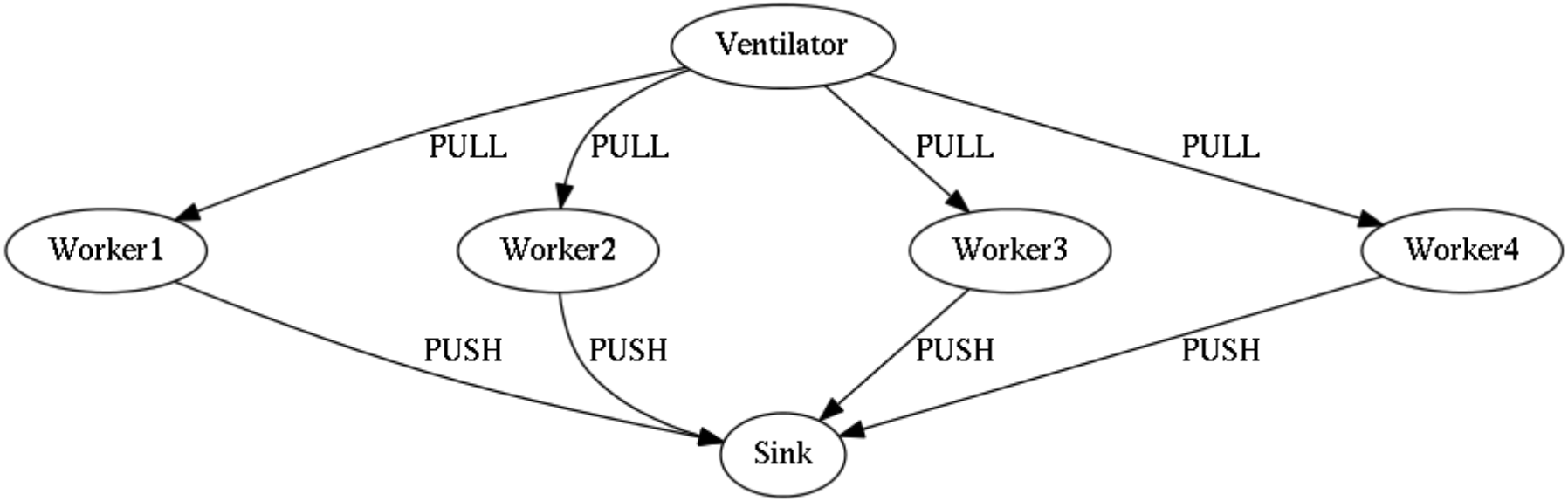
Publish-Subscribe

- fast
- asynchronous
- delivery not guaranteed



Divide and Conquer

- distributing work between workers
- based on PUSH/PULL



Useful stuff

- zactor - thread abstraction
- zpoller - handling multiple sockets
- zhash, zlist, zring
- zbroker
- zbeacon & zgossip

Going deeper - Zproto

- code generator for ZeroMQ
- xml based templates
- generates readable czmq code
- can be used to describe protocol
- can be used to describe state machine

⇒ Helps you get started much much faster!

Zproto protocol - xml

```
<message name = "DIRECT">
  Client sends a message to a specific client
  <field name = "address" type = "string">
                Client identifier</field>
  <field name = "headers" type = "dictionary">
                Content header fields</field>
  <field name = "content" type = "msg">
                Content, as multipart message</field>
</message>
```

Zproto protocol - api

```
#define ZCCP_MSG_DIRECT 6

//  Create a new zccp_msg
zccp_msg_t * zccp_msg_new (int id);
//  Get/set the address field
const char * zccp_msg_address (zccp_msg_t *self);
void zccp_msg_set_address (zccp_msg_t *self,
                           const char *format, ...);

//  Encode the DIRECT
zmsg_t * zccp_msg_encode_direct (const char *address,
              zhash_t *headers, zmsg_t *content);

//  Send the DIRECT to the output in one step
int zccp_msg_send_direct (void *output,
              const char *address, zhash_t *headers,
              zmsg_t *content);
```

Zproto protocol - server xml

```
<state name = "connected" inherit = "external">
  <event name = "SUBSCRIBE">
    <action name = "store new subscription" />
    <action name = "send" message = "SUBSCRIBE OK" />
  </event>
</state>

<state name = "external">
  <event name = "*">
    <action name = "send" message = "INVALID" />
    <action name = "terminate" />
  </event>
  <event name = "expired">
    <action name = "terminate" />
  </event>
 </state>
```

Zproto protocol - server c

- generated C file with with server actor

```
zactor_t *server = zactor_new(zccp_server, "server");
if(verbose)
  zstr_send(server, "VERBOSE");
zstr_sendx(server, "BIND", "ipc://@/server", NULL);
```

- generated stubs for unknown actions

```
static void store_new_subscription(client_t *self) {
}
```

What next?

ZGuide:

http://zguide.zeromq.org/

Github:

https://github.com/zeromq/